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<b>UTILITY PATENT APPLICATION TRANSMITTAL</b> <small>(Only for new nonprovisional applications under 37 CFR 1.53(b))</small>	Attorney Docket No.	8733.20015
	First Inventor or Application Identifier	Woong Sik CHOI
	Title	Reflection Type Liquid Crystal Display Device Having a High Aperture Ratio

<b>APPLICATION ELEMENTS</b> <small>See MPEP chapter 600 concerning utility patent application contents</small>	<b>ADDRESS TO:</b> Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
<p>1. <input checked="" type="checkbox"/> Fee Transmittal Form (e.g. PTO/SB/17) (Submit an original and a duplicate for fee processing)</p> <p>2. <input checked="" type="checkbox"/> Specification Total Pages <input type="text" value="9"/></p> <p>3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) Total Sheets <input type="text" value="2"/></p> <p>4. <input checked="" type="checkbox"/> Oath or Declaration Total Pages <input type="text" value="1"/></p> <p>a. <input checked="" type="checkbox"/> Newly executed (original or copy)</p> <p>b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. §1.63(d)) (for continuation/divisional with box 15 completed)</p> <p>i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §1.63(d)(2) and 1.33(b).</p> <p>5. <input type="checkbox"/> Incorporation By Reference (usable if box 4B is checked) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4B, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.</p>	<b>ACCOMPANYING APPLICATION PARTS</b> <p>6. <input checked="" type="checkbox"/> Assignment Papers (cover sheet &amp; document(s))</p> <p>7. <input type="checkbox"/> 37 C.F.R. §3.73(b) Statement <input type="checkbox"/> Power of Attorney (when there is an assignee)</p> <p>8. <input type="checkbox"/> English Translation Document (if applicable)</p> <p>9. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input type="checkbox"/> Copies of IDS Citations</p> <p>10. <input type="checkbox"/> Preliminary Amendment</p> <p>11. <input checked="" type="checkbox"/> White Advance Serial No. Postcard</p> <p>12. <input type="checkbox"/> Small Entity Statement(s) <input type="checkbox"/> Statement filed in prior application. Status still proper and desired.</p> <p>13. <input type="checkbox"/> Certified Copy of Priority Document(s) (if foreign priority is claimed)</p> <p>14. <input checked="" type="checkbox"/> Other: Request for Priority Check for \$836.00</p>
<p>15. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below:</p> <p><input type="checkbox"/> Continuation <input type="checkbox"/> Divisional <input type="checkbox"/> Continuation-in-part (CIP) of prior application no.: Prior application information: Examiner: Group Art Unit:</p>	
<p>16. Amend the specification by inserting before the first line the sentence:</p> <p><input type="checkbox"/> This application is a <input type="checkbox"/> Continuation <input type="checkbox"/> Division <input type="checkbox"/> Continuation-in-part (CIP) of application Serial No. Filed on</p> <p><input type="checkbox"/> This application claims priority of provisional application Serial No. Filed</p>	
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APPLICATION FOR  
UNITED STATES PATENT  
IN THE NAME OF  
  
**WOONG SIK CHOI**

for

**REFLECTION TYPE LIQUID CRYSTAL DISPLAY DEVICE HAVING A HIGH  
APERTURE RATIO**

## CROSS REFERENCE TO RELATED ART

This application claims the benefit of Korean Patent Application No. 1998-51185, filed on November 27, 1998 which is hereby incorporated by reference.

## BACKGROUND OF THE INVENTION

### 1. Field of the invention

The present invention relates to a liquid crystal display (LCD) device, and more particularly to a reflection type liquid crystal display device having a high aperture ratio.

### 2. Description of the Related Art

An aperture ratio of a liquid crystal display device is a rate of an area which a light penetrates with respect to an entire area of the pixel, and is important for picture quality of the device. One of the methods for increasing the aperture ratio of the reflection type LCD device is shown in Figs. 1 and 2, where the reflective pixel electrode 10 is extending over the data lines 2 and 4.

Fig. 1 is a plan view of a pixel module 100 of a conventional liquid crystal display device. Fig. 2 is a sectional view of the active matrix display device taken along a line of Fig. 1. Module 100 is positioned in between gate lines 6 and 8 adapted for carrying gate drive signals to the pixel modules and data lines 2 and 4 adapted for delivering data signals to the pixel modules. Gate line 8 has a gate electrode 18, data line 2 has a source electrode 12, and reflective pixel electrode 10 is connected to drain electrode 14 of TFT "T" through contact hole.

As shown in Figs. 1 and 2, in order to increase the aperture ratio, the pixel electrode 10 overlaps the data lines 2 and 4, and the aperture ratio of the device is increased by the overlapped length  $\Delta L$ .

However, since reflective pixel electrode 10 and adjacent pixel electrodes 10a and 10b overlap data lines 2 and 4, respectively, the overlapped length  $\Delta L$  is limited to taking into account misalignment of margin "A", which is about 4  $\mu\text{m}$ . Furthermore, if a misalignment happens during the fabrication process, the parasitic capacitance of the overlapped portion varies, which may cause a vertical crosstalk.

## SUMMARY OF THE INVENTION

An object of the present invention is to provide a reflection type LCD device having a high aperture ratio.

Another object of the present invention is to provide a reflection type LCD device which can minimize reflection by data lines.

Another object of the present invention is to provide a reflection type LCD device which can minimize crosstalk.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

According to one preferred embodiment of the present invention, a liquid crystal display device comprises a substrate; first and second gate lines formed on the substrate; first and second data lines intersecting the first and second gate lines so as to define a pixel region, wherein each one of the first and the second data lines has longitudinally separated first and second regions; an insulating film covering the first and the second gate lines and the first and the second data lines; a switching element disposed in the pixel region and connected between the second gate line and the pixel electrode; and a pixel electrode disposed in the pixel region and overlapping at least one of the first and the second regions of the first and second data lines. The liquid crystal display device is driven by an alternating current driving method.

According to one aspect of the present invention, the pixel electrode overlaps the first and the second data lines by whole width of the data lines and by a substantially half length of the data lines. The pixel electrode is a reflective pixel electrode. Preferably, the first and the second regions of the data lines are approximately the same in size. The pixel electrode extends over the first region of the first data line and extends over the second region of the second data line.

A method of manufacturing a liquid crystal display device of the present invention comprises the steps of providing a substrate; forming first and second gate lines on the substrate; forming first and second data lines to intersect the first and second gate lines so as to define a pixel region, wherein each one of the first and the second data lines has

longitudinally separated first and second regions; forming an insulating film over the first and the second gate lines and the first and the second data lines; forming a switching element in the pixel region and connected between the second gate line and the pixel electrode; and forming a pixel electrode in the pixel region to overlap at least one of the first and the second regions of the first and second data lines.

Other elements, features, advantages and components of preferred embodiments of the present invention will be described in further detail with reference to the drawings attached hereto.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate preferred embodiments of the present invention and, together with the description, serve to explain the principles of the present invention.

Fig. 1 is a plan view of a reflection type active matrix display device according to the prior art;

Fig. 2 is a sectional view of the active matrix display device taken along line II-II of

Fig. 1;

Fig. 3 is a plan view a reflection type active matrix display device according to the present invention; and

Fig. 4 is a sectional view of the active matrix display device taken along line IV-IV of Fig. 5.

### **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

The preferred embodiment of the present invention will be explained with reference to the accompanying drawings.

Fig. 3 shows a pixel of the reflection type active matrix LCD device according to an embodiment of the present invention. Fig. 4 is a sectional view taken along line IV-IV of Fig. 3.

First data line 50 and second data line 52 are extending along in a matrix column direction. In a matrix row direction, first and second gate lines 56 and 54 are shown. Two data lines 50 and 52 and two gate lines 56 and 54 define a pixel region. The data line 50 (52) is connected to a source electrode 60. The gate line 56 (52) is connected to a gate electrode 58. A reflective pixel electrode 64 electrically contacts drain electrode 8 through a contact hole 63 on drain electrode 62.

The thin film transistor includes active layer 72, gate electrode 58, source electrode 60, and drain electrode 62. Reference numerals 70 and 74 designate insulating layers, and numeral 1 designates a substrate.

The pixel electrode 64 preferably overlaps the data lines 50 and 52 in equal areas. That is, the overlapped area "B" between reflective pixel electrode 64 and first data line 50 is substantially the same as the overlapped area "Ba" between reflective pixel electrode 64 and second data line 52 in order to reduce the cross talk. Furthermore, the overlapped areas "B" and "Ba" each substantially covers one-half of the data lines 50 and 52, respectively, defining a larger pixel region which in turn increases the aperture ratio.

In this embodiment, the polarity of the row selection voltage waveforms applied to each data line is preferably inverted or reversed at each frame. This is referred to as an alternating current drive scheme and is generally adapted for driving the LCD device.

Since the driving method for the LCD device is alternating current drive and the pixel electrode overlaps the first and second data lines in equal areas, each parasitic capacitance of "B" area and "Ba" area is equal and offsets each other, which can reduce crosstalk.

Since each pixel electrode 64 extends over one-half the length of data lines 50 and 52, substantially the whole length of each data line 50 (52) is covered by reflective pixel electrode 64, which can increase the aperture ratio of the device, and black matrix over data lines 50 and 52 are not necessary.

Various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of this invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein but rather that the claims be broadly construed.

**WHAT IS CLAIMED IS:**

1. A liquid crystal display device comprising:  
a substrate;  
first and second gate lines formed on the substrate;  
first and second data lines intersecting the first and second gate lines so as to define a pixel region, wherein each one of the first and the second data lines has longitudinally separated first and second regions;  
an insulating film covering the first and the second gate lines and the first and the second data lines;  
a pixel electrode disposed in the pixel region and overlapping at least one of the first and the second regions of the first and second data lines; and  
a switching element disposed in the pixel region and connected between the second gate line and the pixel electrode.
2. The liquid crystal display device of claim 1, wherein the pixel electrode overlaps the first and the second data lines by whole width of the data lines and by a substantially one-half length of each one of the first and the second data lines.
3. The liquid crystal display device of claim 1, wherein the pixel electrode is a reflective pixel electrode.
4. The liquid crystal display device of claim 1, wherein the first and the second regions are approximately the same.
5. The liquid crystal display device of claim 1, wherein the liquid crystal display device is driven by an alternating current driving method.
6. The liquid crystal display device of claim 1, wherein the pixel electrode extends over the first region of the first data line and extends over the second region of the second data line.

7. The liquid crystal display device of claim 2, wherein the pixel electrode extends over the first region of the first data line and extends over the second region of the second data line.

8. The liquid crystal display device of claim 5, wherein the pixel electrode overlaps the first and the second data lines by whole width of the data lines and by a substantially one-half length of each one of the first and the second data lines.

9. The liquid crystal display device of claim 5, wherein the pixel electrode is a reflective pixel electrode.

10. The liquid crystal display device of claim 5, wherein the first and the second regions are approximately the same.

11. The liquid crystal display device of claim 5, wherein the pixel electrode extends over the first region of the first data line and extends over the second region of the second data line.

12. A method of manufacturing a liquid crystal display device, comprising the steps of:

providing a substrate;

forming first and second gate lines on the substrate;

forming first and second data lines to intersect the first and second gate lines so as to define a pixel region, wherein each one of the first and the second data lines has longitudinally separated first and second regions;

forming an insulating film over the first and the second gate lines and the first and the second data lines;

forming a switching element in the pixel region and connected between the second gate line and the pixel electrode; and

forming a pixel electrode in the pixel region to overlap at least one of the first and the second regions of the first and second data lines.



13. The method of claim 12, wherein the pixel electrode overlaps the first and the second data lines by whole width of the data lines and by a substantially one-half length of each one of the first and the second data lines.

14. The method of claim 12, wherein the pixel electrode is a reflective pixel electrode.

15. The method of claim 12, wherein the first and the second regions are approximately the same.

16. The method of claim 12, wherein the liquid crystal display device is driven by an alternating current driving method.

17. The method of claim 12, wherein the pixel electrode extends over the first region of the first data line and extends over the second region of the second data line.

18. The method of claim 14, wherein the pixel electrode extends over the first region of the first data line and extends over the second region of the second data line.

19. The method of claim 16, wherein the pixel electrode overlaps the first and the second data lines by whole width of the data lines and by a substantially one-half length of each one of the first and the second data lines.

20. The method of claim 16, wherein the pixel electrode is a reflective pixel electrode.

21. The liquid crystal display device of claim 16, wherein the first and the second regions are approximately the same.

22. The liquid crystal display device of claim 16, wherein the pixel electrode extends over the first region of the first data line and extends over the second region of the second data line.

## ABSTRACT OF THE DISCLOSURE

A reflection type liquid crystal display device includes first and second gate lines, first and second data lines intersecting said first and second gate lines, an insulating layer covering said data lines, and a pixel electrode overlapping the first and second data lines in order to  
5 increase the aperture ratio. The overlapped area between the pixel electrode and the first data line and the areas between the pixel electrode and the second data line are substantially the same with each other. Each overlapped area covers substantially half of the length of the data line. Consequently, the reflective pixel electrodes cover the data lines substantially on the whole.

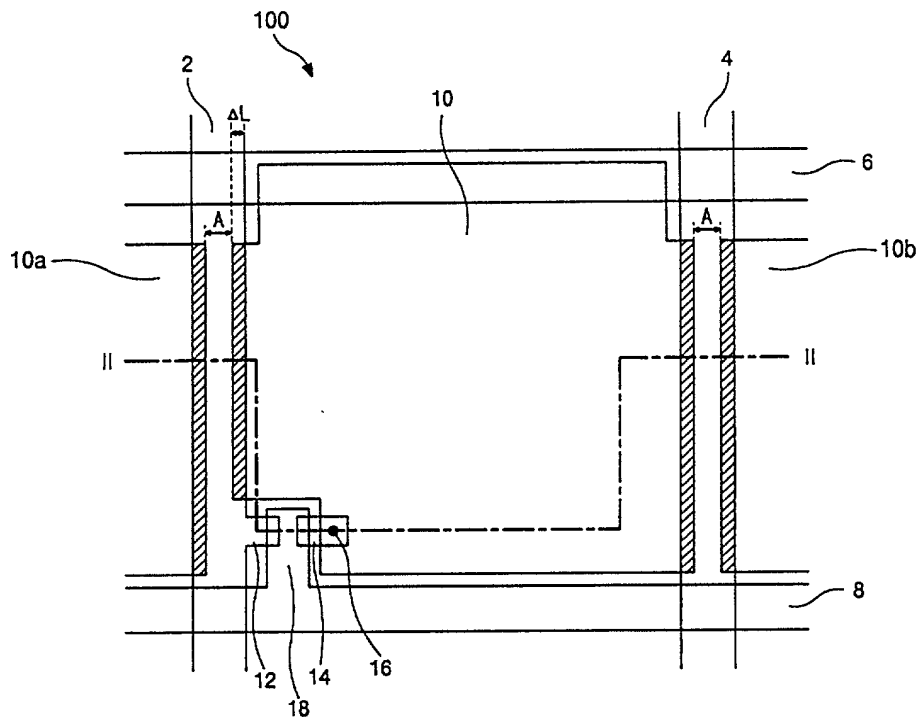


FIG. 1

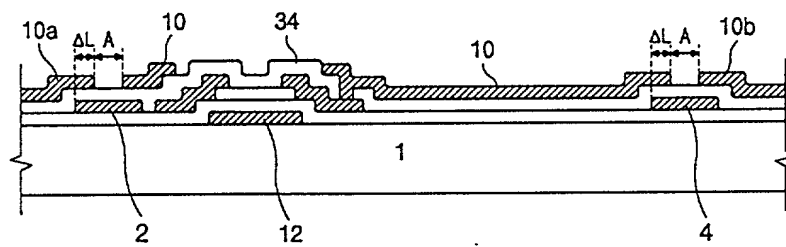


FIG. 2

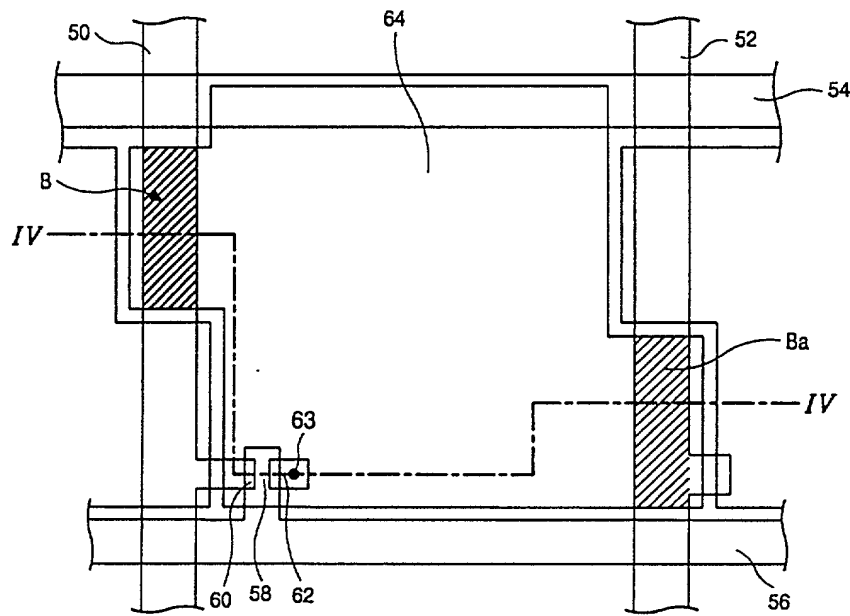


FIG. 3

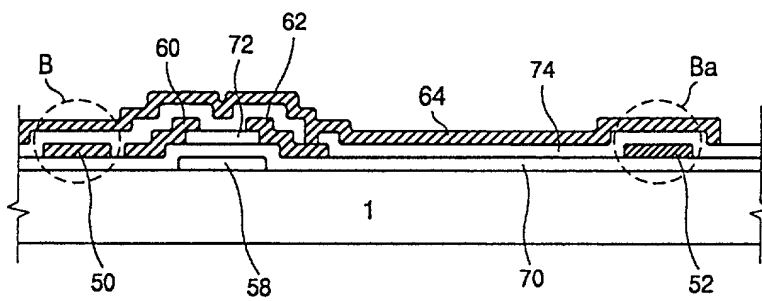


FIG. 4

**DECLARATION  
and POWER OF ATTORNEY**

As a below named inventor, I declare that the information given herein is true, that I believe that I am the original, first and sole inventor if only one name is listed at 1 below, or a joint inventor if plural inventors are named below at 1-4, of the invention entitled:

Reflection Type Liquid Crystal Display Device Having a High Aperture Ratio

which is described and claimed in ☒ the attached specification, or ☐ the specification in Application No. \_\_\_\_\_ filed \_\_\_\_\_ ☐ as amended on \_\_\_\_\_ (if applicable),

and for which a patent is sought, and that my residence, post office address and citizenship are as stated below next to my name

I acknowledge my duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, 1.56(a).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)			
COUNTRY	APPLICATION NUMBER	DATE OF FILING Month Day Year	PRIORITY CLAIMED UNDER 35 U S C 119
KOREA	1998-51185	November 27, 1998	YES

I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Number)

(Filing Date)

(Status)

**POWER OF ATTORNEY.** As a named inventor, I hereby appoint the following attorney(s) and/or Agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith

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		Post Office Address				COUNTRY OF CITIZENSHIP

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon

Signature of INVENTOR 1 Woong Sik CHOI	Signature of INVENTOR 2
DATE: 1999.11.10	DATE
Signature of INVENTOR 3	Signature of INVENTOR 4
DATE:	DATE: